Genetic evidence for a new species of *Berardius* in the North Pacific

NOAA FISHERIES

Southwest Fisheries Science Center, La Jolla, CA, USA

- Phillip A. Morin, C. Scott Baker, Reid S. Brewer, Alexander M. Burdin, Merel L. Dalebout, James P. Dines, Ivan Fedutin, Olga Filatova, Erich Hoyt, Jean-Luc Jung, Morgane Lauf , Charley Potter, Gaetan Richard, Michelle Ridgway, Kelly M. Robertson, Paul R. Wade

Oct. 2013: Genetically distinct stock of Baird's beaked whale near Japan.

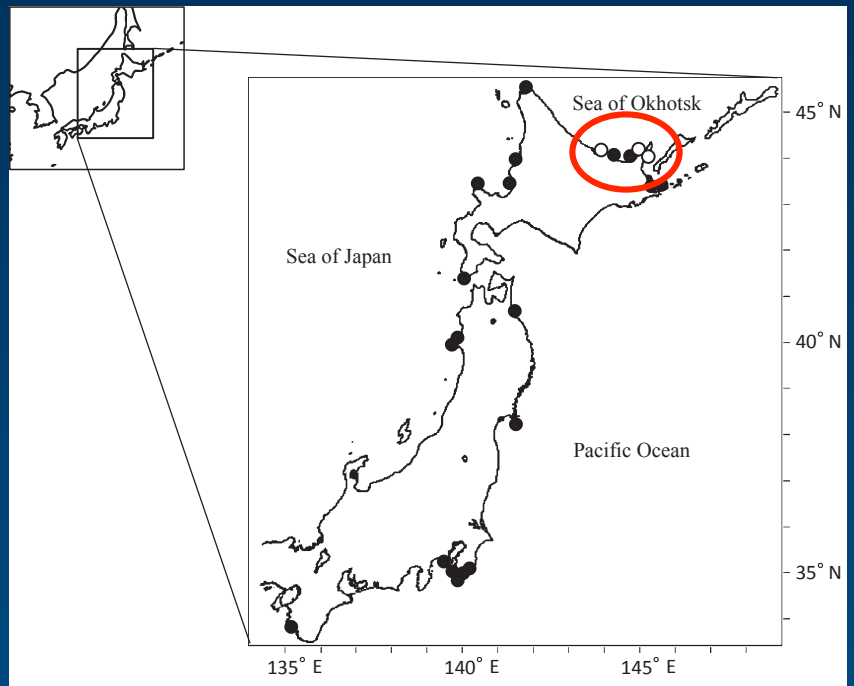
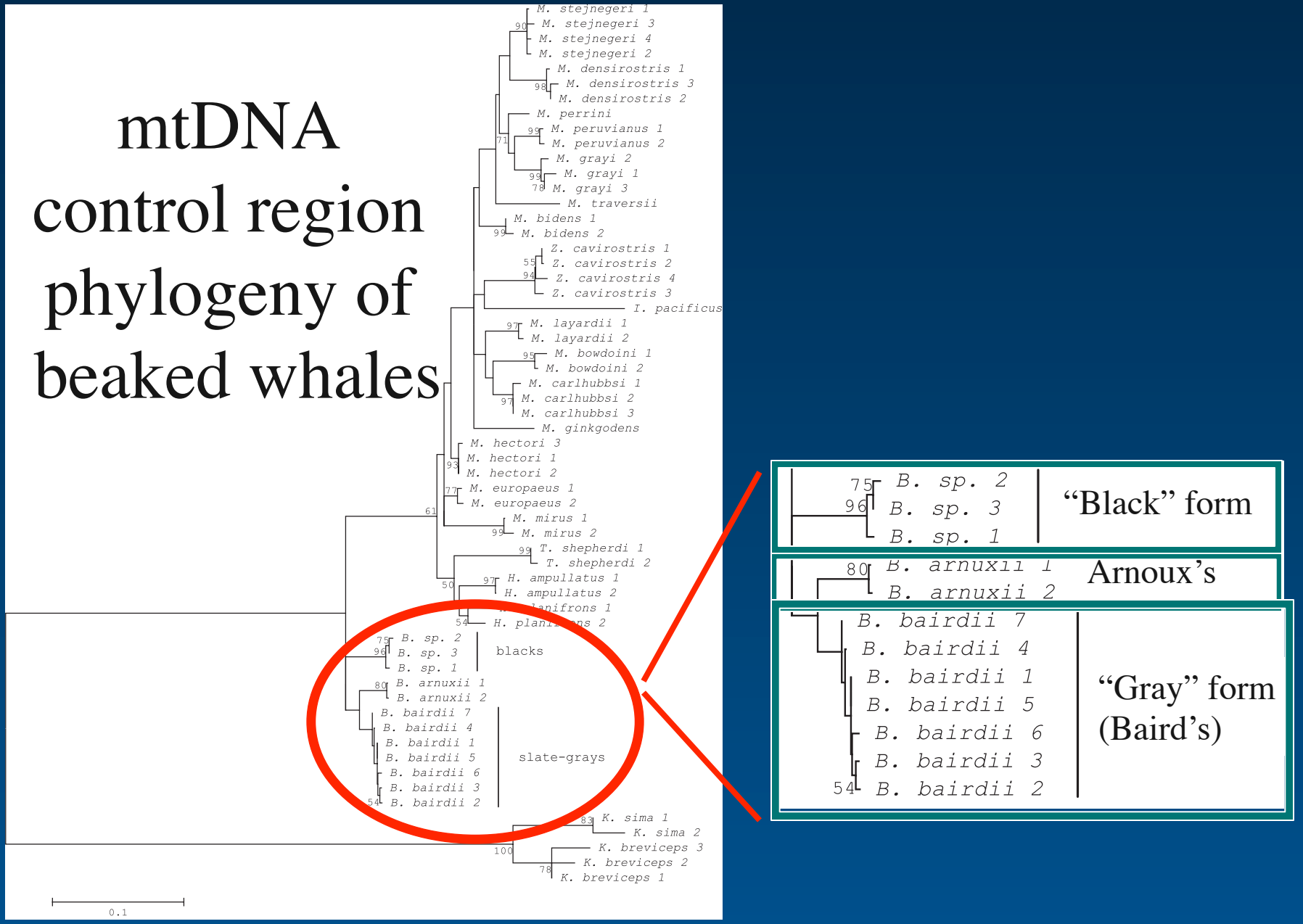


Figure 1. Sampling locations of Baird's beaked whale around Japan. Closed circles for the slate-grays and open circles for the blacks. See Table S1 for detailed site name and the number of individuals at each site.

Kitamura et al., 2013: Two genetically distinct stocks in Baird's beaked whale (Cetacea: Ziphiidae). Marine Mammal Science 29(4): 755-766.

mtDNA control region phylogeny of beaked whales



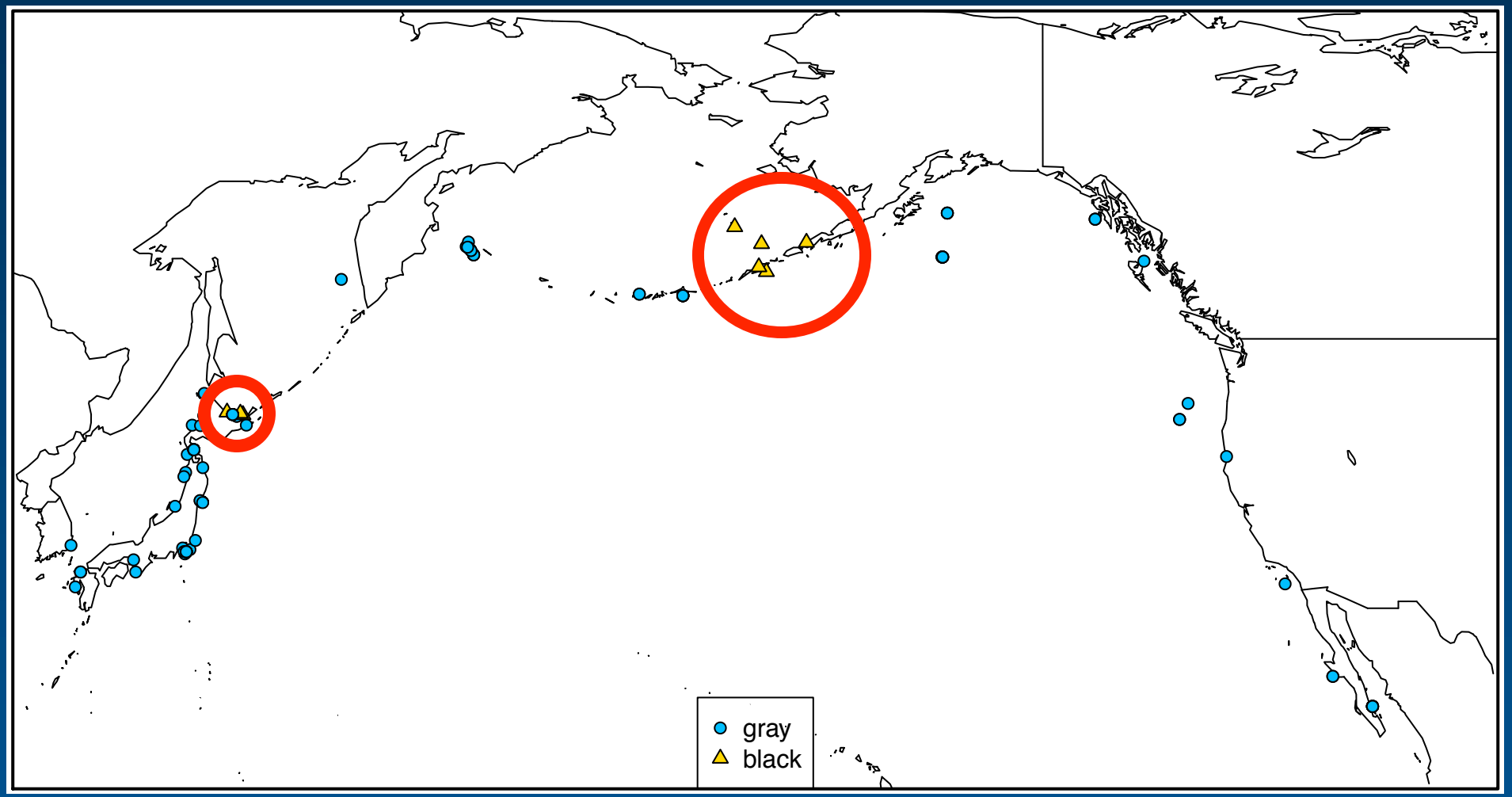
Kitamura et al., 2013: Two genetically distinct stocks in Baird's beaked whale (Cetacea: Ziphiidae). Marine Mammal Science 29(4): 755-766.

Expanding the search

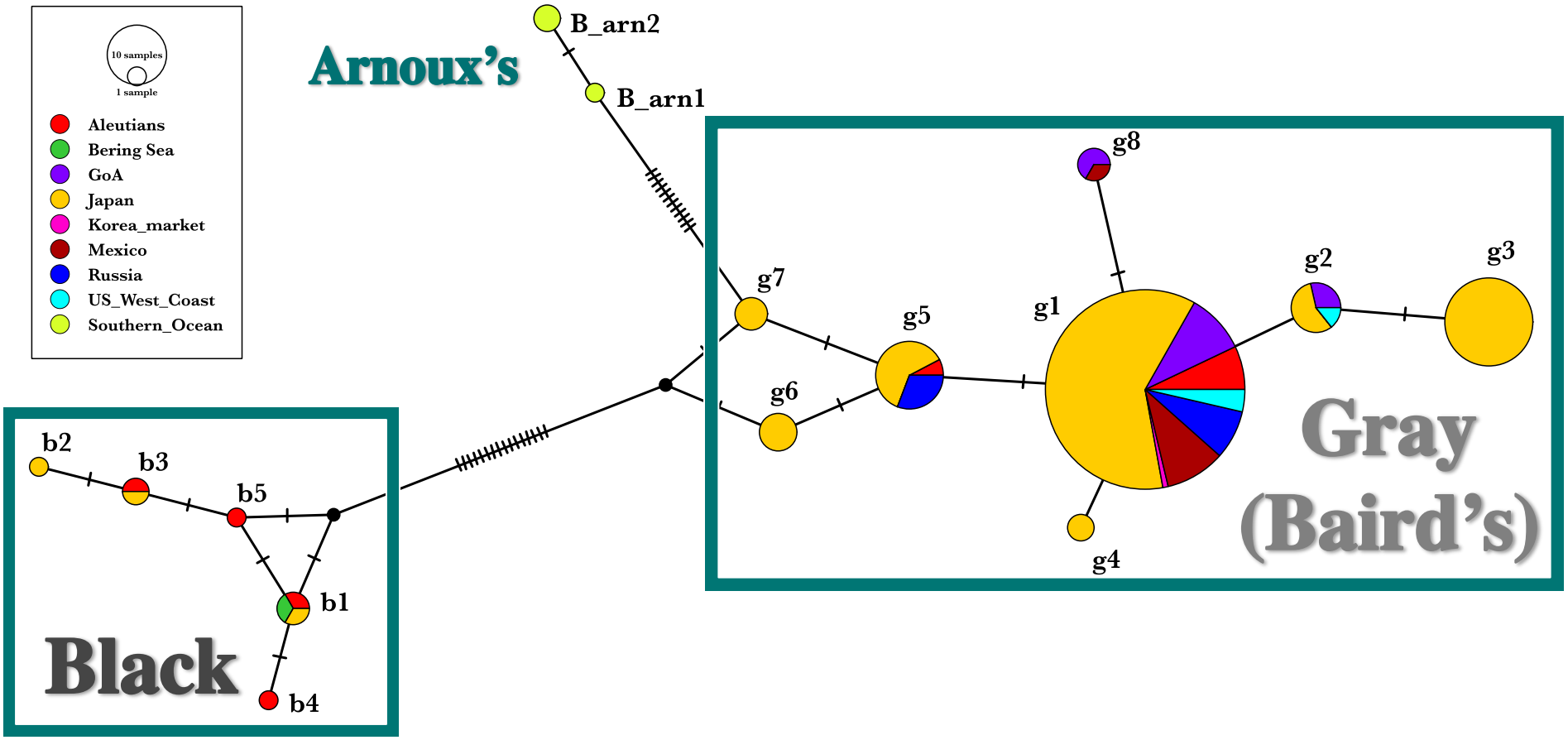
- 46 sequenced from SWFSC collection
- Collaborator contributions/published
  - 13 Commander Island (Olga Filatova et al, sequenced by Jean-Luc Jung)
  - 49 Japan market samples (Scott Baker/Merel Dalebout)
  - 64 Japan samples from Kitamura *et al*. 2013

- New stranding on St. George Is., Pribilofs, June 2014
- LACM sample, 1993 (small adult, Bering Sea)
- NMNH skull, 1948 (ID by T. Yamada as possible black form)

- 175 samples total


gray
black

432bp haplotype network

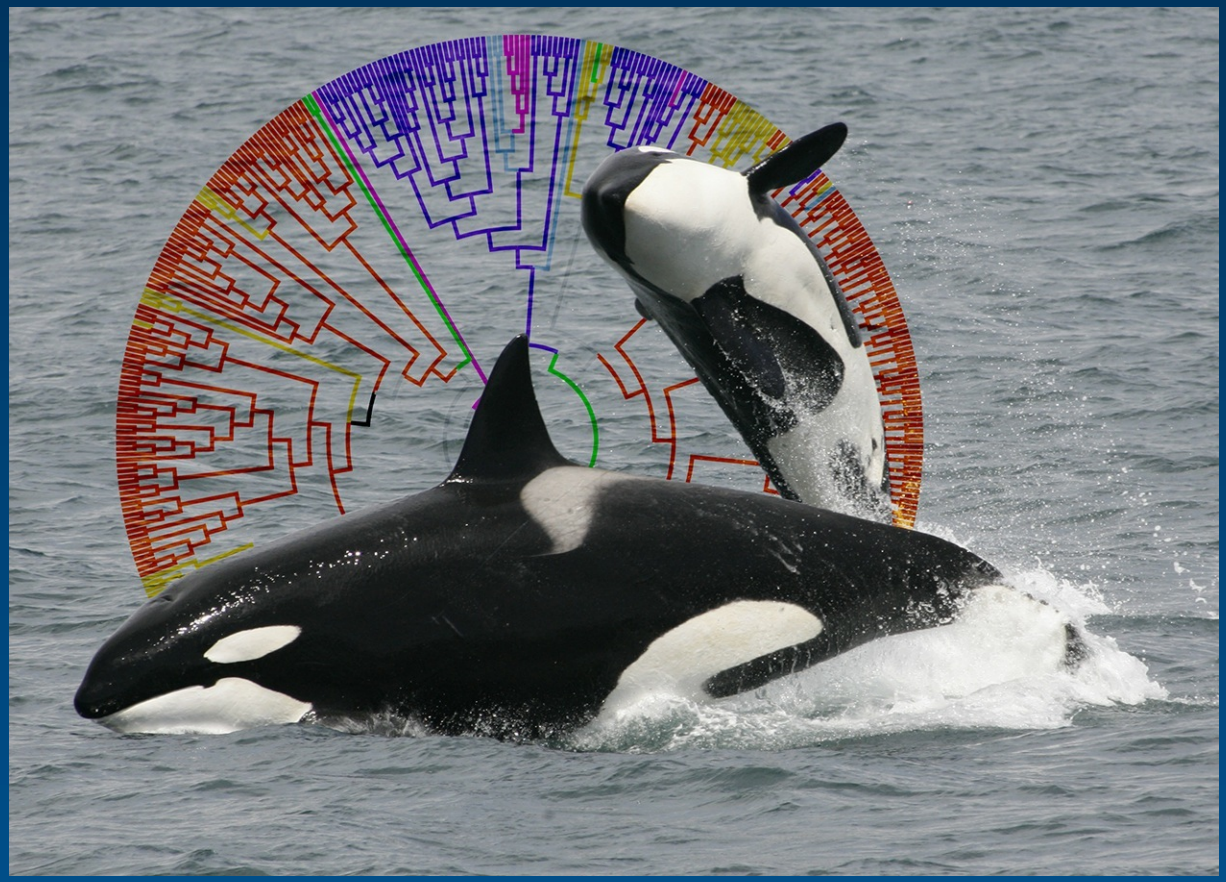


Subspecies or species?

- Black form is more different from the two recognized species than they are from each other
- Genetic divergence measures are similar to what is found in other recognized species (Rosel et al. submitted)
- Range-wide divergence across the North Pacific (not clinal)

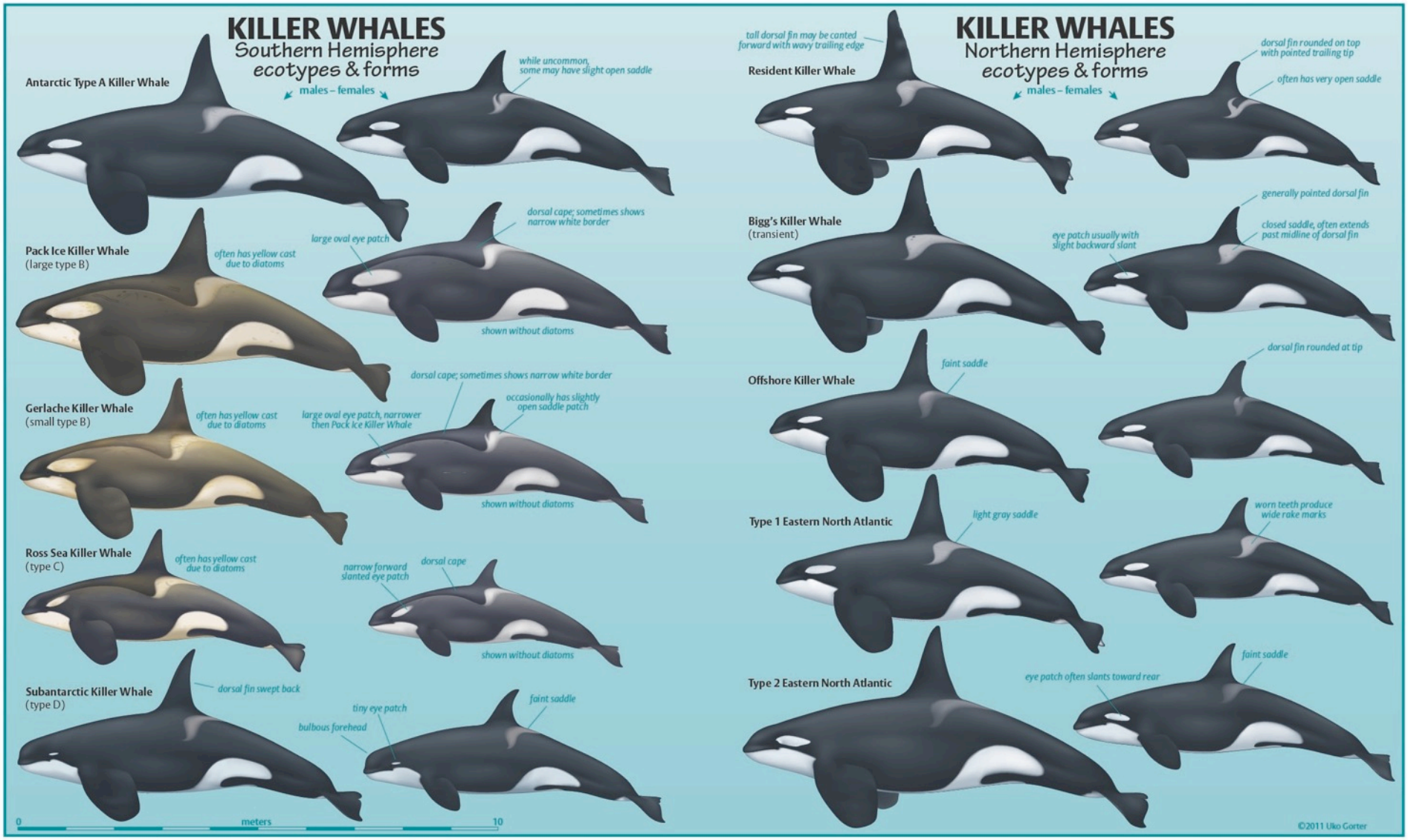
Strata	Net divergence (d_A)	Diagnostic sites
Baird's, Arnoux's	0.028	10
Black, Baird's	0.043	16
Black, Arnoux's	0.060	24

Killer whale global phylogeography



Phillip A. Morin, Kim M. Parsons, Frederick I. Archer, María C. Ávila-Arcos, Lance G. Barrett-Lennard, Luciano Dalla Rosa, Sebastián Duchêne, John W. Durban, Graeme M. Ellis, Steven H. Ferguson, John K. Ford, Michael J. Ford, Cristina Garilao, M. Thomas P. Gilbert, Kristin Kaschner, Craig O. Matkin, Stephen D. Petersen, Kelly M. Robertson, Ingrid N. Visser, Paul R. Wade, Simon Y. W. Ho, Andrew D. Foote

SWFSC
Other NMFS


KILLER WHALES
Southern Hemisphere
ecotypes & forms
males – females
Antarctic Type A Killer Whale
while uncommon, some may have slight open saddle
Pack Ice Killer Whale
(large type B)
often has yellow cast due to diatoms
large oval eye patch
dorsal cape; sometimes shows narrow white border
shown without diatoms
Gerlache Killer Whale
(small type B)
often has yellow cast due to diatoms
large oval eye patch, narrower then Pack Ice Killer Whale
dorsal cape; sometimes shows narrow white border
occasionally has slightly open saddle patch
shown without diatoms
Ross Sea Killer Whale
(type C)
often has yellow cast due to diatoms
narrow forward slanted eye patch
dorsal cape
shown without diatoms
Subantarctic Killer Whale
(type D)
dorsal fin swept back
tiny eye patch
bulbous forehead
faint saddle
0
meters
10
KILLER WHALES
Northern Hemisphere
ecotypes & forms
males – females
tall dorsal fin may be canted forward with wavy trailing edge
Resident Killer Whale
dorsal fin rounded on top with pointed trailing tip
often has very open saddle
Bigg's Killer Whale
(transient)
generally pointed dorsal fin
eye patch usually with slight backward slant
closed saddle, often extends past midline of dorsal fin
Offshore Killer Whale
faint saddle
dorsal fin rounded at tip
Type 1 Eastern North Atlantic
light gray saddle
worn teeth produce wide rake marks
Type 2 Eastern North Atlantic
eye patch often slants toward rear
faint saddle
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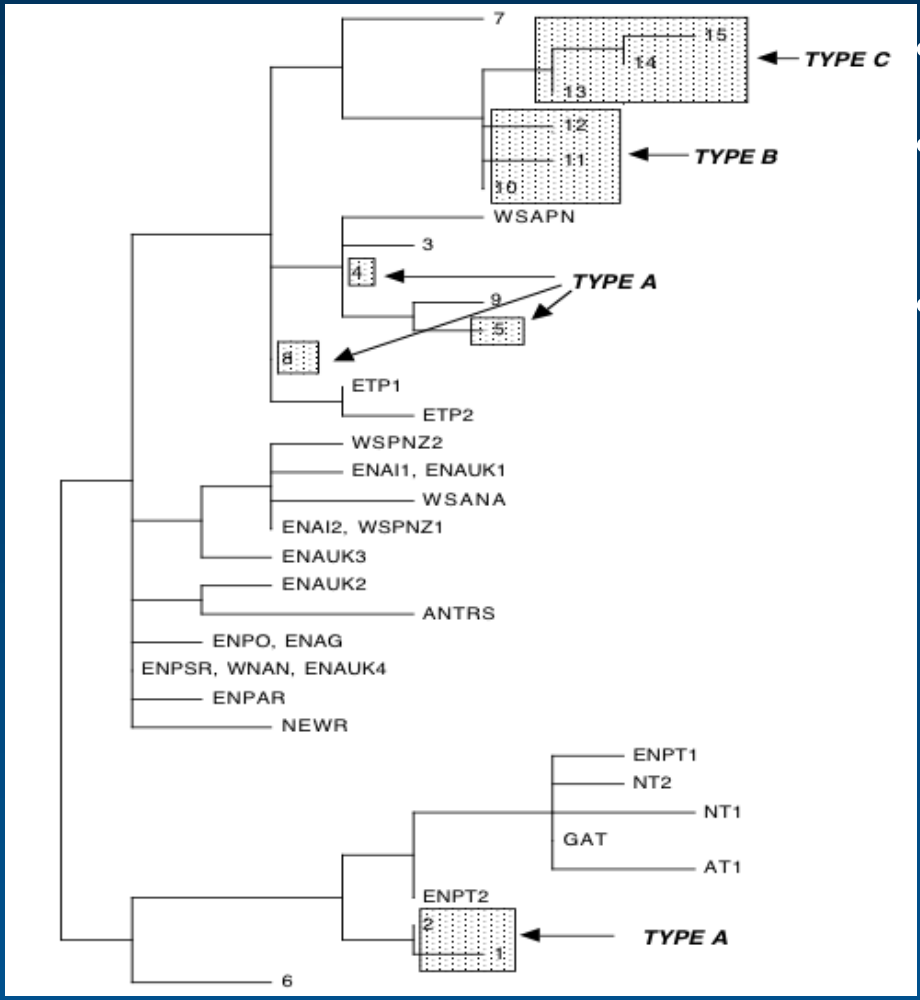
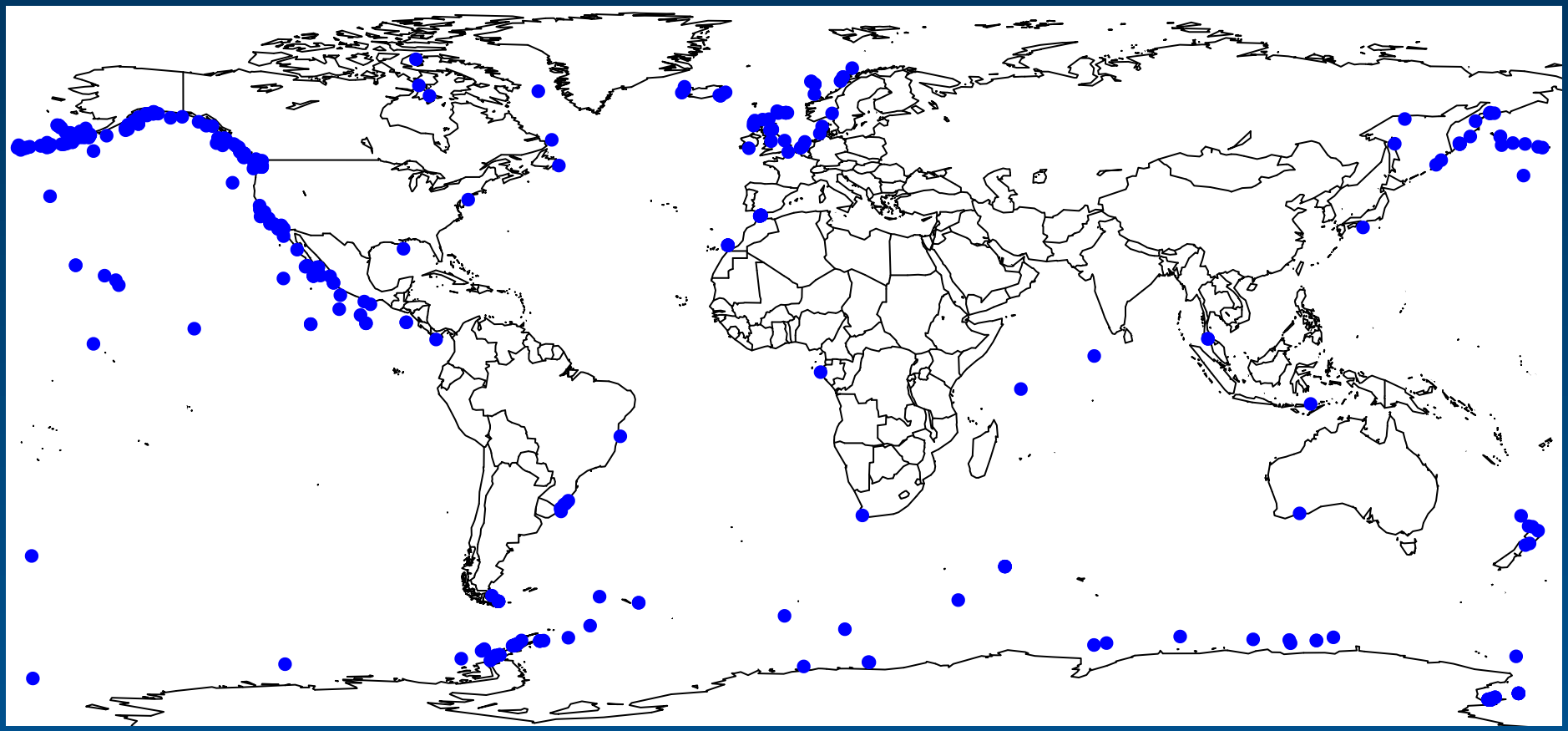
Genetics: mtDNA control region



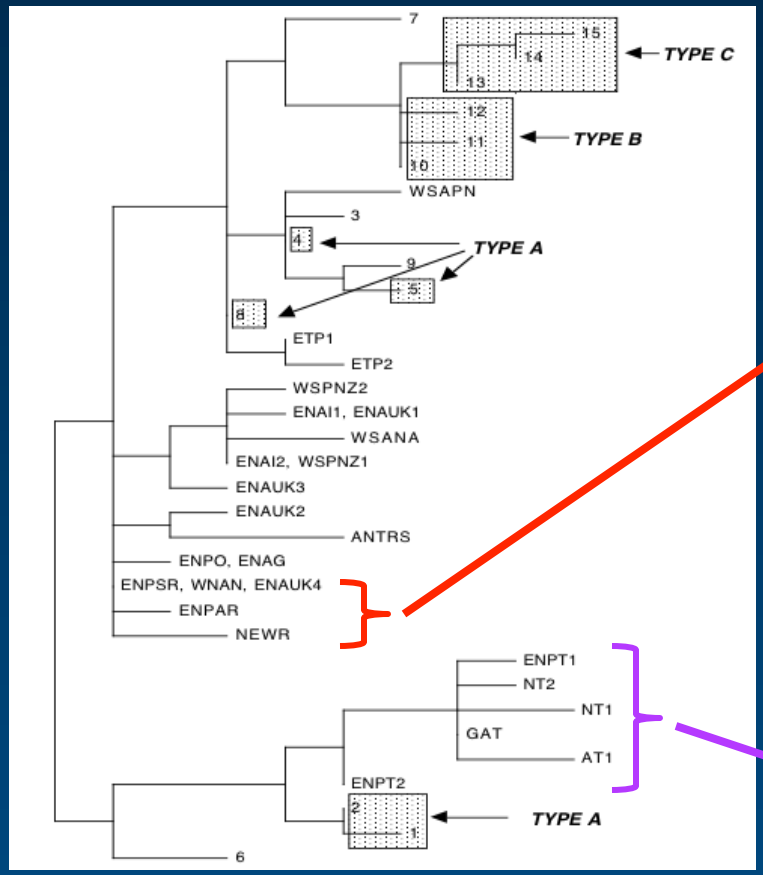
LeDuc et al. 2008

- Hoezel 2002, LeDuc et al. 2008
- Little global structure, but some structure among Antarctic ecotypes
- Inferred recent bottleneck and stochastic lineage sorting into high latitude populations.

Sampling global diversity:
452 complete mitochondrial genomes

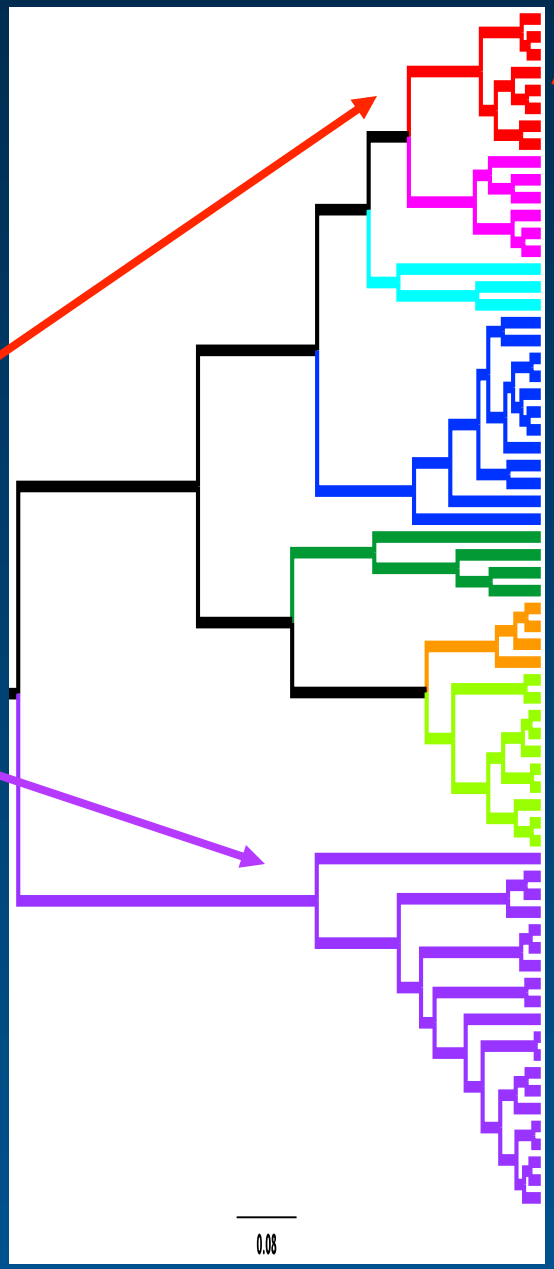


mtDNA control region



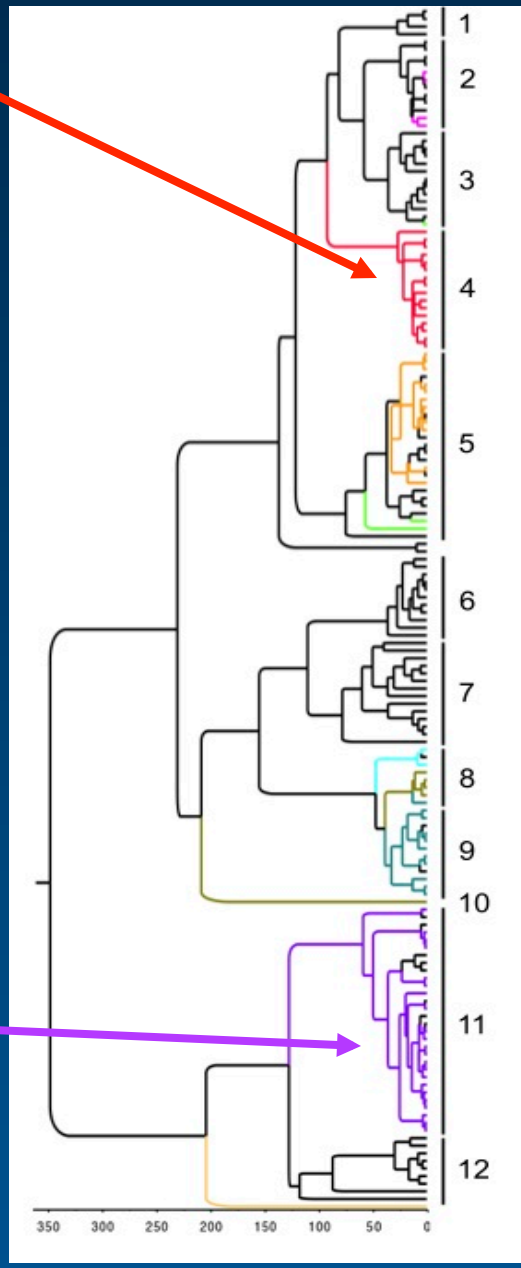
LeDuc et al. 2008

Mitogenome, ecotypes



Morin et al. 2010

Mitogenome, global



Morin et al. 2015

Implications

- Strong evidence of genetic isolation between sympatric ecotypes
- Recent, complex global radiation
- Global perspective and genomic data shed light on regional patterns relevant to management
- Still recognized only as single, global species with 2 unnamed subspecies; taxonomy in need of revision